

REMARKS

Claims 1-4, 6-8, 10, 12-15, 17-18, and 20 are rejected under 35 U.S.C. 102(e) as being anticipated by Lin, *et al.* (U.S. Publication No. 2004/0106067 - hereinafter "Lin"). Claims 5 and 16 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lin. Claims 9, 11, and 19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lin in view of Yeo, *et al.* (European Patent No. 0825492 - hereinafter "Yeo"). In view of the amendments to the claims and the following remarks, it is believed that the claims are allowable over the cited references. Accordingly, reconsideration of the rejections is respectfully requested.

The applicants' invention comprises the steps of patterning a mask layer or photoresist layer to form a first mask pattern or first photoresist pattern having a first width larger than a predetermined width. The first mask/photoresist pattern is thermally treated to form a second mask/photoresist pattern having a second width smaller than the first width. The first width of the first mask/photoresist pattern is gradually reduced in response to the thermal treatment until the second mask/photoresist pattern is formed having the second width. A difference between the first width and the second width is less than about 100 nm.

These features of the applicant's invention are illustrated at least at Figures 4A - 4C of the present specification. In this example, a first photoresist pattern 142 is formed having at least one first width L1 (see Figure 4B). A thermal flowing process (TFP) is performed on the first photoresist pattern 142 at a temperature of about 140-180 degrees C. During the thermal flowing process (TFP), a sufficient temperature is applied to the first photoresist pattern 142 to reduce a critical dimension (CD) size (in this example, the first width L1) of the photoresist pattern 142 (see Figures 4B- 4C). The first width L1 of the first photoresist pattern 142 is gradually reduced through the thermal flowing process to form a second photoresist pattern 144 having a second width L2. A difference between the first width L1 and the second width L2 is less than about 100 nm. Next, a polymer layer 180 is formed on the second photoresist pattern 144 (see Figure 4D), whereby the polymer layer 180 reacts with the second photoresist pattern 144 to form a third photoresist pattern 146 having a third width substantially identical to a predetermined width DL (see Figures 4E-4F). In this manner, the present invention can form a minute photoresist pattern

having a critical dimension (CD), for example, the third width substantially identical to a predetermined width DL that is below 100 nm, while overcoming the conventional difficulty in controlling a reduction of the critical dimension (CD) when the temperature applied during the thermal flowing process is raised above a glass transition temperature.

The Lin reference discloses that a first thermal process is performed to diffuse the photo generated acids formed within the photoresist layer and to equalize the glass transition temperature  $T_g$  of the photoresist layer (see Lin, Figure 2, and column 2, paragraph [0017]). However, contrary to statements in the Office Action at page 2, section 2, it is submitted that Lin fails to teach or suggest thermally treating a first mask/photoresist pattern to form a second mask/photoresist pattern having a second width smaller than the first width. Further, it is submitted that Lin fails to teach or suggest that the second mask pattern is formed by gradually reducing the first width in response to the thermal treatment, as claimed. Instead, Lin discloses at columns 2 and 3, paragraph [0019] that the first thermal process is carried out under a temperature lower than the glass transition temperature ( $T_g$ ) of the first photoresist. This feature is also pointed out by the Examiner in the Office Action at page 3, fourth paragraph. The critical dimension (CD) is reduced when the temperature applied during the thermal flowing process is raised above a glass transition temperature. Since there is no mention in Lin of increasing the temperature above the glass transition temperature  $T_g$ , it therefore follows that there is no gradual reduction in width during the first thermal process of Lin.

In addition, since Lin fails to teach or suggest a second mask/photoresist pattern having a second width smaller than the first width, it therefore follows that Lin fails to teach or suggest forming a polymer layer on the second mask/photoresist pattern, as claimed.

Further, with regard to the rejections of independent claims 1 and 13, it is submitted that Lin fails to teach or suggest that the difference between the first width and the second width is less than about 100nm, as claimed. Instead, as cited in the Office Action at page 4, section 6, Lin teaches a fine pattern formation for DUV lithography below 100nm. However, for reasons described above, Lin fails to teach or suggest a second mask pattern having a second width. Moreover, while the applicant agrees with the Office Action at page 4, section 6, that Lin is

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concerned with reducing the width of the photoresist to a width that is below 100nm, there is no mention in Lin that the difference between the first width and the second width is less than about 100nm, as claimed (emphasis added).

For these reasons, it is submitted that Lin fails to teach or suggest these specific elements set forth in the amended claims. Reconsideration of the rejections of claims 1-4, 6-8, 10, 12-15, 17-18, and 20 under 35 U.S.C. §102(e) based on Lin is respectfully requested.

With regard to the rejections of dependent claims 5 and 16, independent claims 1 and 13 are amended above to include the limitations of dependent claims 5 and 16, respectively, and dependent claims 5 and 16 are now canceled. Accordingly, the rejections of claims 5 and 16 under 35 U.S.C. § 103(a) based on Lin are overcome.

With regard to the rejections of claims 9, 11, and 19, it is submitted that Yeo, like Lin, fails to teach or suggest thermally treating the first mask/photoresist pattern to form a second mask/photoresist pattern, as claimed. In addition, Yeo, like Lin, fails to teach or suggest that the second mask/photoresist pattern is formed by gradually reducing the first width in response to the thermal treatment, as claimed. In addition, Yeo, like Lin, fails to teach or suggest a difference between the first width and the second width that is less than about 100nm, as claimed. In addition, Yeo, like Lin, fails to teach or suggest forming a polymer layer on the second mask pattern, as claimed.

It is therefore submitted that neither Lin nor Yeo teaches or suggests the elements of the claims set forth above. Specifically, neither Lin nor Yeo teaches or suggests thermally treating the first mask/photoresist pattern to form a second mask/photoresist pattern having a second width smaller than the first width, as claimed. In addition, neither reference teaches or suggests that the second mask/photoresist pattern is formed by gradually reducing the first width in response to the thermal treatment, as claimed. In addition, neither reference teaches or suggests that a difference between the first width and the second width is less than about 100 nm, as claimed. In addition, neither reference teaches or suggests forming a polymer layer on the second mask pattern, as claimed.

Since the Lin and Yeo references fail to teach or suggest these claimed features, there is

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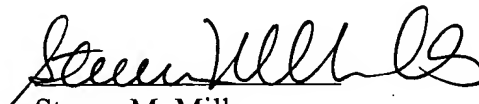
no way to combine the references to obtain teaching or suggestion of the claimed features, and, therefore, there is no combination of the references that teaches or suggests the invention as set forth in the amended claims.

Since Lin and Yeo, taken alone or in combination, fail to teach or suggest the present invention set forth in the amended claims, dependent claims 9, 11, and 19 are believed to be allowable over the cited references. Accordingly, reconsideration of the rejections of claims 9, 11, and 19 under 35 U.S.C. § 103(a) based on Lin and Yeo is respectfully requested.

In view of the amendments to the claims and the foregoing remarks, it is believed that all claims pending in the application are in condition for allowance, and such allowance is respectfully solicited. If a telephone conference will expedite prosecution of the application, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

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